AN ESSAY

ON

ORGANIC REMAINS,

AS CONNECTED WITH

AN ANCIENT TROPICAL REGION

OF

THE EARTH.

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To the American Philosophical Society.

Having concluded to commit to the press some ideas I have formed relative to the position of the Organic Remains of the Earth in a Former Tropical Latitude, I take the liberty to dedicate the Essay to the Society.

Respectfully,
THOMAS GILPIN.

Philadelphia, 23d November, 1843.

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ON THE POSITION

OF THE

ORGANIC REMAINS OF THE EARTH.

In taking a view of the organic remains on the surface or crust of the earth, there appears to be a relation of general position in which they are placed to each other, which has not claimed attention from the geologists; and if, on examination, the facts should be found consistent, they will also refer to a previous state of the earth, and to different influences from those under which it now moves.

To advance in a new theory upon a subject of extensive relation, is generally attended with difficulties; in this case they arise from intervening circumstances, which may appear to forbid a general hypothesis; for, as it regards the earth, the diversities at its surface, and the nature of its own internal constitution, would tend to cast uncertainty upon any theory, be it ever so reasonable. But science has occasionally to reconcile anomalies. It would not have been accredited at an earlier state of geology, that the greater part of Europe has been a marine basin, that the mountain summits are occasionally formed of rocks belonging, in their proper places, to the lowest situations; that the largest mountains have been raised out of the ocean, and their strata turned and contorted by the power both of internal and external forces.

But notwithstanding these disturbances, and the action of the great waters, which have changed so much the surface of the earth and the relation of its lands, seas, and mountains; there is left evidence of a great uniform zone of tropical climate, which favoured the existence of vegetable and animal productions of the land and ocean, and formerly surrounded the globe, differently situated from the present tropics; and it appears in the organic remains and oceanic deposits, wherever this region is found above the water.

It is intended, therefore, to adduce evidence of this fact from natural history, rather than to decide upon testimony relative to causes which have produced it.

The great collection or mass of these remains, will be discovered to encircle the earth in a very uniform direction; it passes from a northerly position in Asia and Europe, south-westwardly, through North America and the Pacific Ocean; and returning from its limits in the southern hemisphere, it unites again in northern Asia. In this belt, there is comprised the great collection of vegetable and animal remains of which we have an account; and it appears to be sufficiently uniform in its place and direction, to be distinguished as the Great Organic Zone or Belt of the Earth.

It is evident that in this circuit, it is not consistent with any of the present influences upon the earth, nor with any of the cycles, climates, and temperatures of its present position, and shows a state of the earth pre-existent to any written account handed to us.

Should this view of the natural history of the earth be established, it will offer a new arrangement in geology; for the organic formations will be found to relate to a peculiar state of the surface, as well as to the internal order of the stratifications; and it is probable that both have been effected by a change in the position of the poles and the equatorial movements.

The great differences of situation in which many of the tropical productions of a former period are found, from those which they occupy at present, have been subjects of continual observation; but it has not been noticed that they could be attributed to the influences of a consistent or corresponding temperature, which appears to have encircled the earth obliquely, and to have favoured the tropical productions, through what are now the regions of the northern and southern hemispheres. These alterations seem to have been brought about by sudden as well as gradual changes in the relations of the earth; as the effects of both are to be discovered upon it.

Notwithstanding the superficial irregularities arising from mountainous elevations and low extended levels, the range of the organic remains of the former regions, is found to be of sufficient exactness to claim for it the distinction of a great elementary district, perhaps of less breadth than that which now contains the tropical products, and to induce a belief that great masses of the inferior tribes of vegetation may have grown or been cast upon it by some great catastrophe.

The climate of the organic belt has not only been favourable to the production of tropical vegetation and vegetable remains, but the subsequent *diluvial relics* of the great animals have been found more largely along the same district than on any other part of the earth; and as it is probable the same mildness of climate favoured the developement of these animals, their remains are a kind of sequence of the former state of things, with scarcely any distinction in the causes which have led to their position.

These diluvial remains are found in immense masses in northern Asia, on the ocean shores, and near the river Lena, and westward through Europe; and they continue with the organic zone through Canada, the United States, and Texas. After leaving America, they may be traced with it through New Zealand, New Holland, China, Siam, and Central Asia.

The principal remains yet discovered in the organic tropical belt, have been found chiefly towards its northern limit, and they do not there lead round the earth in a great circle of the sphere; they pass the equator dividing it into segments of about 140 and 220 degrees.

On their greatest northern extension, they reach to a latitude of about 60 degrees, and on their southern border to about 35 to 40 degrees, thus extending over a large proportion of the continents; but as a similar influence no doubt prevailed over a breadth of zone corresponding to the present tropic, its effect will appear upon the position and growth of the plants and remains throughout its more southern portions.

A circle, to pass over the countries referred to, may be described on the globe with a radius of 66½ degrees—the distance from the pole to the tropic—from a centre on or near to 40 degrees north latitude, and nearly on the meridian of London carried over into the Pacific Ocean. This centre will be about the parallel of Pekin, and equidistant from the shore of China and the northwest coast of America.

Such a circle would be a tropic of Cancer to a pole thus situated, and as the fossils of the organic zone are all tropical, they seem to have spread over a region in obedience to such a state of terrestrial revolution.

The globe, under this arrangement, would have had the land and ocean very differently situated from their present state; and in the progress of its elementary change many of the organic remains could not have settled regularly in their present order; some may have been enclosed in lakes or among ridges of mountains, or passed into shallow beds and held up at various levels.

An observation of R. J. Murchison, President of the Geological Society, is made on the Silurian Geology of England, and though local, leads to the same idea. (See Murchison's Silurian System, page 148.)

"In some parts of England, as Shropshire, certain coal measures consist of fresh-water strata, and may have originated in lakes; while others not far distant were deposited in estuaries, where the sea obtained access occasionally to them; while a third class was formed at the bottom of an open sea, or in bays of salt water, into which land plants became drifted."

"In many parts of France and Germany," says Charles Lyell, in Elements of Geology, page 256, "there are isolated patches of coal strata, entirely free from marine fossils, which repose on granite, and other hypogene rocks; they are, however, confined to a small area; as, in the Department of the Loire, at Brassac, in Silesia, and a hundred other places. All these deposits have been formed in lakes, existing in the islands of that sea in which the mountain limestone was formed." See also Burat's D'Aubuisson, vol. ii. page 268.

There are many of the lower levels of Europe, particularly the extensive low country between the Baltic and Euxine seas, which, before the alteration or depression of the present ocean surface, were under water; and this may have been the case with nearly all Africa, the plane country of Arabia and Southern Asia, the lower planes of the United States of America, of Texas and South America: and even now, most of these countries show appearances of having been so; while the mountainous region of Southern Europe, the Himalaya region of Asia, Mount Atlas in Africa, the Andes, and the Apalachian or Alleghany chain in the United States, would have appeared as islands or shores, if the elevation of some of them had not taken place at the same time with that of some of the marine bottoms.

But all this great region is remarkable for the features of former life of one uniform character. Wherever the organic relics have been discovered, they are *the vegetable and animal remains of products of tropical regions, and of a climate of equatorial heat.* Their further production terminated by a change of climate, and they became fossil and embodied in diluvium during repeated changes of the waters.

To sustain such an hypothesis, it is only necessary to advert to the facts which are in detail through all the geological discoveries, and to the accurate and extensive information in the possession of gentlemen of scientific study, and to show how they are applicable to this problem.

If a commencement is made at the high northern latitudes of Russia, it must be observed that *there* the zone, as at the extreme parts of the ecliptic, passes over a long distance of longitude with little change of latitude, before it approaches obliquely towards the tropic: and thus a greater quantity of organic remains may be found on the northern parallels of latitude, than on its decline towards the equator; and this may be also the case on the southern hemisphere; but the passage of the zone can only be traced there over some of the islands.

The great northern range of *the organic remains* is fully set forth by the geological writers on the discoveries along the northern region of Asia, and from the river Lena towards Europe.

In Mantel's Wonders of Geology, vol. i. p. 138, the following account is given of the great animal remains found on the shores of the great northern Asiatic Ocean, which, though not strictly of the character of the fossil remains, were indigenous to that region, but lived there only during a very mild state of the atmosphere.

"In Russia, more particularly in Siberia, the fossil bones of elephants are found throughout all the low lands, and in the sandy plains; but not in the elevated primary chain of hills stretching from the borders of Europe to the nearest extreme point of America, and south or north from the base of the mountains of Central Asia to the shores of the Arctic Sea.

"Within this space, which is almost equal to the whole of Europe, fossil ivory is every where to be found.

"In Siberia alone, the remains of a greater number of elephants have been discovered, than are supposed to exist at the present time all over the world. In a low island in the frozen sea, (lat. 72° north,) bones of mammoths are seen embedded, and they also abound in an iceberg on the northwest angle of the American continent, near to Behring's Straits."

In this northern region the phenomenon of the Siberian elephant has been described by Professor Adams in 1806, where he saw it embedded in the ice; but as that also of the rhinoceros is included in one account by G. A. Mantel, it will be more concise to refer to both together. See Mantel's Geology, p. 139.

"But the most remarkable fact relating to these remains is the preservation, not merely of the bones, but of entire animals with their flesh and skin in icebergs and frozen gravel! In 1774, near Vilhouie, a branch of the river Lena, in northern Russia, the carcass of a rhinoceros was taken from the frozen sand, where it must have been concealed for ages,—the soil of that region being always frozen to within a few inches of the surface,—the carcass being a complete natural mummy, part of the skin being still covered with long hairs.

"The discovery of a mammoth" (synonyme of the Arabic word behemoth, meaning elephant) "under similar circumstances, is still more interesting."

"Toward the close of the last century, a Tungusian fisherman discovered in a cliff of ice and gravel, on the bank of the river Lena, a shapeless mass, the nature of which he was unable to determine; in this state it remained so as to be seen repeatedly during five summers from 1798 to 1803, until, in the spring, when an early thaw set in, the entire carcass of a mammoth was exposed, and it fell down upon the beach. It was 12 feet in height, and about 16 feet long," (some accounts say it was 21 feet long;) "the tusks were 9 or 10 feet long; the flesh being sound, was devoured by bears, wolves, and other wild animals: the hunters fed their dogs with the remains. The skin was covered with hair, consisting of black bristles, thicker than horse hair, and 15 inches long; the wool was of a reddish brown, and the hair of a fawn colour, with a mane on the neck. Upwards of 30 pounds of hair were collected. The ear remained dry and shrivelled; the brain, and even the capsule of the eye, were preserved.

"The existing elephants belong but to two species: the African, which occurs as far south as the Cape of Good Hope, and the Asiatic, which is limited to 31° north latitude."

But it is the opinion of M. Cuvier that this elephant, or mammoth, although it may have been overcome by a sudden change of climate and eventually embedded in ice in a region where it must so long since have ceased to exist for want of food, must have been adapted to live in a country somewhat more northern than the Asiatic elephant.

Thus; independently of the proper fossil remains, the most perishable parts of large and heavy animals have been preserved in the northern ices in regions of perpetual cold. This is the only means by which a knowledge of such existences could have been handed to subsequent ages, and it is so out of the course of physical order that no conjecture concerning their condition is reasonable, consistently with our present experiences. These vestiges are of high importance to establish evidences of a former state of the climates of the earth.

The preceding ideas are further confirmed by a reference to Dr. R. Harlan's Researches, page 251, and to his quotations from M. Cuvier, as follow:

"The most celebrated of the extinct species, belonging to known genera; as the fossil elephant, rhinoceros, hippopotamus, and mastodon; are never found with the more ancient genera, but are contained for the most part in diluvial formations.

"The bones of species which are apparently the same with those which still exist alive, are never found except in the light and alluvial depositions, and probably are, strictly speaking, not *fossil remains.*"

It is noted in the same work, page 254, that, "In Europe, the remains of the mastodon and other mammiferæ sometimes occur buried in more recent strata than the erratic block group of De la Beche.

This includes the Elephant or *Mammoth*,[a] and the genera Hippopotamus, Rhinoceros, *Megalonyx*,[b] and *Megatherium*.[c]

There is a mixture of the remains of the *Mastodon*[d] and *Paleotherium*,[e] in the basin of the Loire, deposited in the *Miocene*,[f] or middle tertiary strata.

"In most instances, there is sufficient evidence that these animals died and left their bones to become fossilized in the precise situations they were found, and that they have been destroyed or died subsequently to the action of those causes which formed the beds of gravel or alluvial detritus, in or upon which they are frequently found."

Although it is proper thus to refer to the large masses of animal remains, in connexion with the existence of the organic zone, because they have very much accompanied it; yet, with an alteration of climate, and change for food, animals of this great size and importance must have been in progress in extensive migrations: their feeding ground must have varied with the change of season, and led them to pass over *planes* of great vegetable product, which would require them to be accounted for in large ranges of latitude.

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[a] *Mammoth* or Behemoth, from the Arabic, are synonymes for Elephant.

[b] *Megalonyx*, a great claw animal, from μεγα great, and ονιξ a claw.

[c] *Megatherium*, great beast or animal, from μεγα great, θηριον beast.

[d] *Mastodon*, hill tooth, from μαζος, a nipple or hill, οδους, a tooth.

[e] *Paleotherium*, ancient animal, from Παλαιος, ancient, θηριον, animal.

[f] *Miocene*, less recent, from μειον, less, καιος, recent.

The evidences of this zone, however, will be found not to rest upon migratory testimony, but upon the "habitat" of more resident inhabitants of the land and ocean, and principally upon the vegetable products, *for these have not migrated.*

The tropical zone curves from its high Asiatic latitude southwardly towards the Equator; in this course it may be traced crossing part of Germany, the Peninsulas of Denmark and Holland, and it leaves the continent of Europe after its passage over England and France.

The vegetable fossils are developed through all this region, and in places they are accompanied by the chalk and flint formations, which are the embedded remains of marine productions. The remains are also found of the Elephants, Mammoths, and Mastodons, as well as those of the Hyena, Rhinoceros, Tiger, and animals of the Torrid Zone, in the tertiary or upper soils, besides those which have lived secreted in caves, dens, and bone-caverns in Germany, France, and England.

The evidences are, that this range passes to the southward of Sweden, and that it is limited to the south of France or by the Alpine mountains. Charles Lyell found that "the genera of minerals and fossils were entirely distinct on the south side of the Alps, from those on the north."

"The coal region in Holland," (see Ure's Geology, page 170,) "is large and abundant. In Sweden and Norway, there is no coal, or it is extremely rare."

Archibald Alison, in his recent "History of Europe during the French Revolution," vol. iv. page 16, on the authority of R. J. Murchison, writes, "coal is rarely found in Russia or to the west of the Ural Mountains; or if discovered, it is in such inconsiderable quantities as to be worth nothing.

"The lid of the box in which this valuable mineral is found in the British islands is there: the bottom of red sandstone is also there: but the intermediate seams of coal and ironstone are very rarely found.

"Iron occurs, indeed, at some places, but without coal. Russia can never compete in the supply of great manufactories, &c."[a]

"In Germany," (see Ure, page 170,) "there are great deposits of coal, particularly in Thuringia, and in Saxony, Bohemia, and Silesia.

"In France, there are some of the richest deposits of coal known, they cross the north of France; and it contains there the coal mines of Valenciennes, Conde, Mons, Namur, Liege, &c., and deposits are also in the neighbourhood of Lyons." R. C. Taylor, Esq., of Philadelphia, writes, "there are 46 distinct coal basins in France, which in the year 1838, yielded 3,228,000 tons."

"*Detached portions* of the ancient carboniferous group," says Charles Lyell, Elements, page 256, "extend from central Europe to Melville Island, and to the confines of the Arctic Region, but they do not appear in the south of Europe; for the lignite and coal found south of the Alps and Pyrenees, in Spain, Italy, Greece, and other countries bordering on the Mediterranean, seem referable to the cretaceous, and other comparatively modern groups."

The organic belt crosses England; and there its phenomena are exhibited to every advantage in the innumerable and inexhaustible coal regions,—the deposits of vegetable, animal, and marine fossils, and of the remains of the large animals accompanying them.

Scientific volumes give so full an account of the tropical plants and animals of warm climates imbedded in the geological districts of England, and partially in Ireland, which are discovered on opening every mine, that it may be called a fossil kingdom.

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[a] Iron manufactories are established at Toula, a town lat. 55° N. lon. 37° E. on the river Oupa, a branch of the Oka which flows into the Volga. These extensive iron works are for the supply of the empire.

"The mountain limestone" (Ure, page 171) "beneath the coal of the English mines has been a mineral formation. This is perfectly evident from the nature of the embedded shells; but the vegetable organic remains of the coal measures themselves indicate their strata to have been deposited out of the sea. Successive inundations are known to have occurred about the period of their formation, accounting for the introduction of a few fossils among the coal measures and basaltic caps thrown over them; as, at the basaltic caps near Edinburgh."

The *chalk formation*, as indurated in high cliffs and accompanied by the *flint*, may be said to be *confined to Europe;* and it is largely proportioned to England.

"The chalk formation," (see Mantel, page 430,) "appears to have possessed the principal existing marine types of organization; it teems with many species of the dog-fish, lamna, galeus, and other genera of the shark family; there is evidence that numerous genera, now no more, and others of excessive rarity, swarmed in those seas; the most remarkable peculiarity in its zoological character is in the class of reptiles. But the chalk ocean was not only peopled by Chelonia,[a] but also by two or more enormous Saurians;[b] for the Mosœsaurus[c] lived in the cretaceous seas, and the Ichthyosaurus[d] and Plesiosaurus,[e] inhabited the same deep."

Accompanying the carboniferous region through England, the relics of tropical life in vegetable and animal remains are innumerable, and unbounded in variety.

"In Tilgate Forest, southeast part of England," (says Mantel, page 385,) "are the Fossil Crocodiles, Gavials, those well-known reptiles of Egypt, India, and America, hundreds of bones of every well-known species. The Plesiosaurus remains," (see Mantel, page 389,) "are found in the same forest in prodigious numbers, as well as the Megalosaurus,[a] 40 to 50 feet long, are found in the fossil limestones of Stonefield."

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[a] Chelonia, from χελώνη, a tortoise, animals of the turtle tribe.

[b] Saurus, from Σαυρος, a lizard.

[c] Mosœsaurus, from Maestrich the city, and Σαυρος, the fossil lizard or the lizard of the river Meuse.

[d] Ichthyosaurus, from Εχθυς, a fish.

[e] Plesiosaurus, from Πλεσιον like, Σαυρος Lizard.

"The Iguanodon,[b] a resemblance of the land lizard of the West Indies," (see Mantel, p. 496,) "but to which the Iguana is but one-twentieth the magnitude, was found 70 to 100 feet long, to which the groves of palms, and arborescent ferns would have been mere beds of reeds—and these must have been in prodigious numbers at Stonefield, and with the Pterodactyles[c] or flying reptiles," and the Hyleosaurus[d] lizard of the Tilgate Forest are found there, and also at Solenhaufen," in long. 10° 43′ E. lat. 44° 46′ N. in Germany.

The Ichthyosaurus (so called by Mr. König from its being a lizard resembling a fish,) and the Plesiosaurus, (so called by Mr. Conybeare, from its resemblance to a lizard) of various descriptions, have had their residence in England, where they are taken from the Lias Shale, (or shale layers,) from Lyme Regis, Dorsetshire.

"The fossil plants taken in the different stratifications with which the coal measures abound, are generally discovered to be of Cryptogamous[e] and Monocotyledonous[f] tribes; as palms, rushes, ferns, &c.—they occur in the slates, limestones and sandstones, and it is a curious circumstance that the vegetable impressions from coal strata in North America, New Holland, and various parts of Europe, show a close analogy in the ancient vegetation of these distant countries; indeed there exists a *similarity in the coal formation in every part of the world.* Most of the plants are of tribes and orders now in existence, though in nearly every instance, the species is nowhere to be found."

"The remarkable size of the Cryptogamous plants found in Europe, in a fossil state, indicate by their immense size, a *tropi-*

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[a] Megalosaurus, from Μεγα great, Σαυρος a lizard.

[b] Iguanodon, from the Iguana, and οδους a tooth.

[c] Pterodactyles, from Πτερος, a wing, and Δακτυλος, a finger, winged fingers, like bats.

[d] Hyleosaurus, from the German, *Wald*, a wood or forest.

[e] Cryptogamous, from Χρυπτος, hidden, γαμος marriage, where the flowers are concealed.

[f] Monocotyledonous, from μονος one, κοτολη cotyledon, having one seed-lobe, as in wheat.

cal climate, the remarkable size of the Calamites[a] and Equisetums,[b] produced at the period when the vegetables which now form coal seemed to grow, show that the climate of England, and the higher parts of North America, where these fossil remains are found, were hotter than any region of the earth is at the present day. The equisetums being found from the highest northern, to the hottest southern region, progressively increase in size from the pole to the equator, but never under the equator do they now increase in size to the fossil analogues. The Calamitus approximatus is a fossil species, found in the coal formations of Newcastle, Lubec, Canada, France, and Siberia." (Comstock, p. 245.)

M. Adolphe Brogniart in his treatise on the classification and distribution of fossil plants, makes the same remark, and concludes "that in the strata of coal and anthracite[c] the vegetables preserved are all of immense sizes, some of the equisetums, (horsetails,) lycopodiums,[d] (ground pines or club moss,) some of which grew to an immense size in Europe, say from 10 to 20 feet high, and from 6 to 12 inches in diameter, now grow on the surface of the earth from one to three feet high, and in thickness about the size of a pipe-stem. Specimens from the borders of Canada are more than two feet in diameter; a proof that the climate of North America, as well as Europe, has changed. Plants in the fossil state of the fern kind in some parts of Europe attained to the height of 40 to 50 feet, and the arborescent club mosses were 60 to 70 feet high, no plants of these kinds on the surface, ever attain to one fourth of these sizes."

Thus it appears that the palms, ferns, sugar cane, and sigillaria[e] or tree ferns in all their varieties and of immense sizes, are abundant and luxuriant in the fossil state through England and Europe, which are now only the product of the tropical climates.

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[a] Calamites, from calamus, a reed or rush.

[b] Equisetum, from equus, a horse, and setum, a tail.

[c] Anthracite, from Ανθραξ, a burning coal.

[d] Lycopodiums, from Λυκος, a wolf, and Πους, a foot, wolf's foot.

[e] Sigillaria, from sigillum, a seal, from its resemblance on the stem, left at the foot-stalks of the leaf stems.

The great Elephantine animals seem to have taken their progress through the mild region of this zone and passed with it on the continent, and over the seas to England.

A writer in the transactions of the Geological Society, second series, vol. 6, p. 161, remarks:—"In 1827 an enormous mammoth tusk was found in the deep sea of the German Ocean or British Channel and landed at Barnsgate, its length was nine feet, diameter six inches."

"In 1837, a fisherman took up a mass of enormous bones—a humerus of 45 inches length, on the shoals between Dover and Calais."

"At the back of the Goodwin Sands, an elephant's tusk was dug up: its length was 78 inches, but it was broken off at the alveolar cavity: it was of 12 inches circumference."

"In 1839, Captain Martin obtained a pelvis of a mammoth, which was trawled up in the North Sea, one hundred and twenty miles from where the other femur was obtained: the femur was 49 inches long."

In the Illustrations of Antediluvian Zoology, by R. C. Taylor, F.G.S., he observes that "remains of the mastodons, crocodiles, elephants, &c., were found in Cromer Cliff, Norfolk, in the cave of Kirkdale, and in the peat valleys; they are often taken up by the oyster dredgers, on the same coast," and R. C. Taylor adds that the bones and tusks of the mammoths and large elephantine animals are not only brought out of the ocean, but they are also found frequently along the shore, at the retiring of the tide.

The organic zone, passing in its oblique southwesterly direction through the Atlantic Ocean, comes to the eastern shore of North America.

One of the first evidences of the zone passing into America and corresponding to its appearances in Europe, is given in an account of Researches in Newfoundland in 1842, by Sir Richard H. Bonnycastle.

"On the western side of the island of Newfoundland, amid most profound solitudes and vast prairies, forests and innumerable large lakes, we find the grand mystery almost brought to light, in the continuation of the coal formation of Nova Scotia and Cape Breton, the great coal basin of the St. Lawrence, probably the largest in the world, reaching from the Gaspè territory on the one hand, and covering a vast portion of Newfoundland on the other." Vol. i. page 195.

"Between the mountains and the Gulf of the St. Lawrence, the beds of carboniferous rocks preserve a parellelism with the usual direction of the coast, or N. E. and S. W." Ibid. p. 201.

"In the centre of the S. W. side of St. George's Bay, near Crab river, the lower portion of the carboniferous rocks runs along the coast, amid alternations of red marl and sandstone, the beds usually dipping to the N. W. at an angle of 45°." Ibid. page 202.

"Mr. Jukes calculates the small portion of the coal basin of Newfoundland at about 25 miles wide, by about 10 miles in length." Ibid. page 203.

It is thus fairly presumable that the coal districts of Newfoundland and of Nova Scotia, are a continuation of the same coal range, corresponding with, and being a continuation of the coal formation of England. They are in the same direct range, and separated only by the Atlantic Ocean.

The limestone region forms the bed of the St. Lawrence river, and the eminences at Quebec: the organic remains appear with it.

Charles Lyell, in his fifth Lecture, (it being on the origin of coal,) observes,

"There is nothing more singular, or which has struck me more forcibly in respect to the coal fields of America, than their close resemblance to those of the north of Europe, and of England in particular."

"I have been astonished to find the minerals or fossils different on the north side of the Alps from those on the south, and of entirely different genera from those met with in the Pyrenees; nor has the chain of mountains any thing to do with this remarkable change; for the beds were formed at the bottom of the sea, before the mountains existed."

"Observing this great change in the travel of a few hundred miles, it seems to me most surprising that at the distance of from 3000 to 4000 miles, from England to the Apalachian chain in Virginia, we should find the coal measures the same as those we left behind, represented in the old red sandstone, and containing white grit and slaty shales, and clays not slaty, and beds of conglomerate containing quartz pebbles."

There not having been written an accurate geological account of the interior of Lower Canada, it may be better not to offer any further ideas in regard to it, but pursue the direction of the organic range in its more southernly course.

It is stated, however, that on the coast of Hudson's Bay, coal has appeared; and also at Melville Island; but its extent and general relations have not been described. It may be one of the *isolated patches* or "*detached portions* of ancient carboniferous groups, which extend," as C. Lyell says, "from Central Europe to the confines of the arctic regions and Melville Island."

But wherever coal has existed, it is accompanied or formed from plants of a warm or hot climate, chiefly of the genera and species mentioned, and among them, Charles Lyell has particularly noted the Caulopteris, one of the Sigillaria or tree ferns whose "habitat" is only in the warm and humid regions. Lyell's Elements, pages 248 and 255.

There are occasional appearances of some plants of the general forest growth of the temperate latitudes in the coal formations; but the variety and number is limited, and the species are those which often intermingle in tropical regions with the tropical productions, or in the fossil state may be mistaken for such. Some impressions of the fossil conifera or fir trees are found, but they are either those which have grown in the tropics in high situations, of cold mountainous temperature, or of the araucaria, which is a family of pines now met with in warm latitudes; "but the fir trees of the arctic regions have no representatives in the coal."

It is the opinion of Charles Lyell, grounded upon that of Werner and Adolphe Brogniart, that by far the greater part of the coal has grown upon the spot where it has been discovered, accumulating like peat upon the land. The land must have been submerged again and again, to allow the strata of sand, mud, &c. to become interposed, as they now are found.

Charles Lyell refers also to the experience of Mr. Logan, an eminent geologist, who had examined more than ninety coal seams in Wales, of every thickness, under all of which he found the fire clay, and a sandy mud containing the plants called Stigmaria: this appears, as the miners say, in the under clay.

Without any previous assurance of the plant being with the coal in America, C. Lyell sought for it at Blossburg: "and as soon as the mine was lighted up, it was the only plant which could be found in the under clay; its leaves radiating just as *in Wales, more than* 4000 *miles distant.* In the roofs were seen different species of ferns, the sigillaria and calamites, just as in North Carolina and in Wales. The same phenomenon was observed at Pottsville and at Mauch Chunk, where one was thirty feet long, and with leaves radiating in all directions, at which place there is a bed of anthracite nearly 60 feet thick, a magnificent accumulation of vegetable matter, to which there is nothing comparable in Europe." (Lyell's Lectures, No. 5.)

As there has been a prevailing belief that anthracite coal is not found to advantage in Europe, it may not be here too digressive to remark, that this has been corrected in a letter from Richard C. Taylor, Esquire, in the North American, Oct. 19, 1843.

This valuable communication may be adverted to for its invaluable statistic and comparative views of the coal fields of Europe and America; but the following paragraphs are too relevant to be omitted in a general account of the coal, it being so extensive a depository of the organic remains.

"The important fact, that there exists as large, if not a larger amount of anthracite in the old world than in the new is not without its value as an influential element of trade."

"By far the greater bulk of the coal in Ireland, is pure anthracite. It has been but partially opened, and, till lately investigated, but little known. It occupies several prolonged basins, exclusively anthracite, in five or six counties in southern Ireland. Devonshire in England, has a small anthracite basin, but that of Wales is perhaps the most extensive in the world."

The small quantity of coal in Rhode Island has been scarcely noticed either in use or in Geology. It is not out of the line of continuation of the coal or organic range. But the granite formation in the Eastern States intervenes; and it is more ancient, and below the coal formation.

The organic zone has very much the southwestern direction of the coast of the United States, as far as New Jersey; but after this, as the sea coast is principally of an alluvial character, and inclines to the south, it passes with the mountains into the interior of the continent.

A cretaceous formation exists through the low lands of the state of New Jersey, and to the southward, it passes with the marl which is an under stratum through the lands of Delaware and Maryland.

The interior formation of the intermediate high land between the bays of these states has been developed at the deep cut through the ridge country dug down nearly to the tide level for the passage of the Delaware and Chesapeake Canal, and it shows the alluvion from the upper country to have been brought over the surface of a former vegetation.

The trees and plants which became disinterred consisted of the dicotyledonous vegetation, and the plants of hard woody growth of the temperate zone. Some of the seeds of the annual shrubs of the present latitude were taken from geodes and grew again in the upper soil. But none of the plants which contributed to the carboniferous series were discovered.

The zone appears again above the granite formation in the State of New York, and of the accompanying diluvial relics, the first evidences are of the mastodon remains. The earliest account of these was sent by Dr. Mather, of New England, to Dr. Woodward, in 1712, and related to bones of an enormous magnitude found at Albany, in 1705. It was not far from this locality that Charles Wilson Peale, obtained the mammoth skeleton in 1804, from a sunken morass near Newberg, about 70 miles above the city of New York.

These animals having no doubt been migratory in their habits and destined to procure food from a large tract of country, may have ranged, at a comparatively more recent geological period, somewhat in the manner the buffalo now do, over the lower country, then not intruded upon by man. Their remains have been found in New Jersey, and in the Southern States. But in 1841, mastodon remains were taken up for Charles Lyell, from the lake basin deposits at the Falls of Niagara.

The more veritable organic remains are to be found in the reefs of transition limestone; as, at the gorges of the Catskill Hills; at the Catterskill, and at the Trenton Falls of West Canada Creek; at Glen's Falls of the Hudson river; at Niagara; and wherever the cataracts expose the formations at similar declivities; the small petrified trilobites or other fossil animals and organic substances are found in their extinct varieties, and correspond with those of similar places in Europe.

But in these places, the coal will not appear, these situations and formations being below it.

At Blossburg, on the Susquehanna waters, as they cross the Pennsylvania and New York state line, coal of a bituminous quality is found in Pennsylvania: it is there elevated in the Alleghany or Apalachian range, and it continues in this range as the hills pass southwestwardly through the state.

When Charles Lyell was at Blossburg, in 1841, there was given him by Charles E. Smith, at the coal mines, the Holoptychus found about three miles north of that place, in a reef of the red sandstone; it occurs in the valley wherever there is a denudation of that formation; and this is a further confirmation of its similarity to the same formations in Europe.

The Holoptychus is one of the sauroid fishes, and Dr. W. Buckland, in a note in Bridgewater's Treatise, No. 6, vol. i. p. 43, says: "Mr. Murchison, in 1835, discovered remains of the Megalichthys,[a] Holoptychus,[b] and Coprolites,[c] and several species of Unio, in the Wolverhampton coal field. These great sauroid fishes, first recognised at Edinburgh, September, 1834, have also been detected in the English coal fields of Newcastle-on-Tyne, Leeds, and Newcastle-under-line."

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[a] Megalichthys, from Μεγα, great, Εχθυς, fish.

[b] Holoptychus, from ολος, destructive, Εχθυς, fish.

[c] Coprolites, from Κοπρια, dung or fæces, Λιθος, stone, ossified food found in the entrails of animals.

The mountains pass through Pennsylvania in diagonal ranges southwestwardly; and the deposits of organic remains in the coal, as well as the fossil salt formation, pass with them; but subsequently they take a more westernly direction in the basin of the Ohio river and valley, and extend over the plateau country of the western states.

Through this, there are the same evidences of a tropical fossil district as through Europe, the remains of plants and animals corresponding in number and variety.

The formation of fossil salt in America, is said to be differently situated from that of Europe: it is, in America, below the carboniferous strata; but in Europe, chiefly in the new red sandstone. Col. Ellicott, well acquainted with the geological developements of the interior country, stated that the salt springs from the state of New York to Tennessee, may be traced in a direct line, and on a parallel with the coal and organic district.

In the region of the Ohio and Mississippi, there need be no particular reference made to localities of fossil productions, for they occupy the whole country: their direction is with the coast southwestwardly, and they become more extended in breadth, owing to the flatness of the country.

At the salt springs of the Ohio, called Licks, and especially at the Big Bone Lick in Kentucky, vast quantities of big bones have been discovered. "Mr. Croghan reported, more than eighty years ago, to have found the remains of more than thirty individuals, but a much greater number has since been found there. These bones also occur through Ohio, and Kentucky." (Comstock, page 222.)

Thus the Ohio and Mississippi basins, once the largest and most favoured tropical planes in the world, yielded the tropical plants in their luxuriant growths, at a time when they were the favoured residence of the Mammoth, Mastodon, or Missourium, and of the great lizard tribes; and they are now yielding their fossil remains from the same planes over which they roved, until chilled by the cold of a northern climate, or until vegetation became too limited to maintain them.

It is likely, however, that with a change of climate, and the warmer influences extending more gradually to the southward, their "habitat" towards the latter part of their career may have taken that direction. They are believed to be among the most recent of the extinct fossil tribes of the American continent; and, as the tropical vegetation of the north became diminished, it is not unreasonable to suppose that they passed to the more fertile and warm planes of the south. Their habit being migratory,—their food vegetable,—it is not extraordinary that they have left their bones in the low country far to the south as well as to the north.

De la Beche, remarks, page 69, "The relative age of the deposit in which the American Mastodons are found cannot be considered as satisfactorily ascertained. Some geologists are of opinion, that these animals have disappeared more recently than it is commonly supposed; that is, previously to the commencement of the northern group."

It may be useful to refer to a few particular accounts respecting these animals and fossil remains, in order to support the intention of this problem, and to establish their geological relation.

The *Mastodon* from Big Bone Lick, in Kentucky, and from Ohio, has been found also in Virginia and several of the other states. One from Wythe county, in Virginia, was taken six feet beneath the soil, and M. Cuvier, in his Animales Fossiles, vol. i. page 219, states, that in a kind of sac or stomach there was found a kind of brier, considered as a part of the substance the animal had eaten.

The *Megalonyx*, was taken in 1796, from a cavern in Green Brier county, Virginia, and it is described by M. Cuvier, in (Animales Fossiles, vol. v. part i. ed. 3, page 160,) and it appears to be of the same species as the Megatherium of South America, found near Lima, in Paraguay, and near Buenos Ayres, from which last locality, the carcass was sent to the museum at Madrid.

The *Basilosaurus*[a] was discovered about the year 1830, in the horizontal limestone of Alabama, Lat. 31° north, which formation T. Conrad considered more ancient than the chalk of Europe. (Harlan, Researches, page 352.) It was denominated Lizard King, from its great size, and was computed to be 100 feet long, (Harlan, page 343,) while the Megalosaurus was estimated to be not more than 40 feet, and the Iguanodon about 60 feet long.

The *Ichthyosaurus'* remains were discovered in Missouri, near the mouth of the Yellow Stone River, probably about the year 1830; but they may have been seen there by Lewis and Clarke, on the 10th Sept. 1804, not far from the grand detour, between Shannon and Poncarrar river, near Cedar Island, where they encountered a *petrified fish*, with a back bone, 45 feet long, tapering towards the tail, but in perfect preservation, the fragments of which were sent to Washington. Some ribs and other fragments were also found. (Lewis and Clark's Expedition, edit. 1814, vol. i. page 69; also Harlan, page 341.) All these animals occupied low planes in America, as they did also in England and Europe.

The area of Texas, abounds in diluvial remains of the same character; they are reported to be in immense quantities; they were left on a country of the same description of soil, and having at that time a similar climate; but a more exact account of the fossil remains of Texas is still to be desired.

The high mountain ranges of the Isthmus of Mexico, where fossil remains may next be expected, impose too high a region of elevation to admit of the formation of coal measures, the extensive deposit of fossil remains, or of the general residence of the large animals.

Remains of Mastodon bones were obtained for Humboldt, in Mexico, at 8000 feet above the ocean, at Santa Fé de Bogota, and of another species of Mastodon bones at an equal elevation near Quito. But their places would more properly be found, there, as in Russia, "in the low lands and sandy planes, but not in the elevated primary chain of hills."

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[a] Basilosaurus, from Βαςςιλευς, a King, and Σαυρος a Lizard.

In the Andes range, along the coast of Peru, there have been some discoveries of coal, but as far as these are yet known, it is not further south than would be covered by a tropical breadth in the passage of this zone as it crosses the Mexican isthmus.

In continuing on the prescribed course of this belt of organic life, and following in the direction assumed for it, it passes from the western shore of America southward into the great Pacific Ocean.

It thus crosses the equator in west London longitude at about 110 degrees; it passes south of the Society Islands at longitude 140 to 150 degrees; and then it is found in New Zealand at 180 degrees longitude, on the extended meridian of London, where it is nearly at its southern limit of latitude, 40 or 45 degrees, its course in this neighbourhood passing through many degrees of longitude with little change of latitude.

It is well known that New Zealand abounds in coal, and with it, amidst every temptation of soil and climate for the comfortable residence of mankind; and there the Anglo-Saxon race is becoming rapidly placed, in antiposition with their northern empire, on one of the most favoured spots of the Pacific Ocean.

New Zealand is among that description of islands in the Pacific Ocean which have been found destitute of the existing group of animals. For, with the exception of rats, small dogs and bats, it contained no indigenous mammalia, and but few reptiles, none of which were of large size.

From these islands there has been no general account of organic remains; but the following may be considered as the "Eocene," or early dawn, of what a further developement of those regions may afford to natural science.

The following is an extract from a letter of the Rev. Mr. Williams, who has a flourishing extensive settlement on the island, the position of which is elegantly painted in the panoramic view of the Bay of Islands, and will be fully described at the

Coliseum Rooms at Philadelphia, by Mason Shaw. This letter is dated May, 1842.

"It is about three years ago, on paying a visit to the south coast of the East Cape, I was informed by the natives of the discovery of some large bones of an animal in an inaccessible cavern on the side of a hill near the River Wairoa. But there were many found afterwards at similar positions at Waiaper, Tologa Bay, &c.; and at many inconsiderable streams, and in embedded situations. Some of them were found to be bones of a bird of a gigantic size. There were three bones of the leg, and bones of the pelvis, a few vertebræ, and an imperfect cranium; the largest, a bone of the leg, is 34 inches long. The bones are all fossil, and the following inferences may be drawn from the discoveries.

"1st. The bones have only been found in the banks or beds of fresh-water rivers, buried a little distance in the mud."

"2d. The bird may have been in existence at no very remote period of time, but the bones do not appear to have been brought to their present state by any recent or violent rush of the waters.

"3d. The bones exist in considerable numbers. Mr. Williams has perfect and imperfect bones of no less than thirty individual birds.

"4th. The birds must have been long-lived, as one leg-bone was obtained 34 inches long, and two others of 30 inches.

"5th. The greatest height of the bird was not less than 16 feet; it was 6 feet high from the root of the tail.

"The bird, from its great size, has been named Dinornis.[a] The enormous size of its bones proves it to be the most gigantic of all known birds; the bones are massive, far stouter and broader than those of the other tridactylous struthionidæ;[b] much stouter and broader,—more mammalian, so to speak,—than the apteryæ;[c] and the bulk of the bird must have been great; nor is it by any means certain that the bones found are the largest to be had.

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[a] Dinornis, from Δινος, terrible, Ορνις, bird.

[b] Struthionidæ, the ostrich tribe, from στρȣθος, a sparrow.

[c] Apteryæ, from α negative, and Πτερος, a wing.

"The bones, on their arrival in England, were placed by Dr. Buckland in the hands of Professor Owen."

Leaving New Zealand, the next land the zone passes over is New Holland, or Australia; and the organic remains may be found at the eastern side, as it curves through that country, ascending to the northward. Coal is found abundantly, and it has a large quantity of organic remains.

"Caves and fissures, filled with osseous breccia,[a] in the same manner as in Europe, have been found in New Holland, to the eastward of Sidney, near the bank of the Macquarie River, wherever the red ochreous colour of the European conglomerate prevails. A portion of a large bone found in a cave is said to resemble the leg-bone of the hippopotamus: the general character of the animals is marsupial:[b] but the fossil analogues are all of extinct species. It is, however, of great interest, as it proves that the present zoological character has prevailed from a very remote period." (Mantel, page 179.)

"The fossil ornithorynchus[c] or duck-billed platypus[d] of Australia is noted among the organic remains." (Ibid, page 492.)

In a late publication of a letter from the Rev. Mr. Williams, May, 1842, concerning New Holland, is found the following account:

"On the Darling down, those extensive plains marked to the southwest of Moreton Bay, on most maps of Australia, at the source of the River Darling, and upwards of 4000 feet above the level of the sea, there have been found several huge masses of bones. These have been transmitted to England by Sir Livingstone Mitchell, Surveyor General of Australia, and examined by Professor Owen, who considers them to be referable to either the genus mastodon, or to the Dinotherium."[e]

The appearance of the coal mines and organic remains in New Holland and in these islands of the Southern Ocean, is common with those of Europe and North America; and this is confirmed by the private reports and conversations of some of the gentlemen and naturalists of the late United States Expedition. On their late visit to New Holland, the geological evidences were found to correspond so exactly as to identify the locality of some of the vegetable fossils and coal as those of their own country.

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[a] Breccia, from Βραχας, crash, things broken up.

[b] Marsupial, from μαϱσαυπος, pouch. The kangaroo is also Marsupial.

[c] Ornithorynchus, from Ορνις, a bird, θηριον, a beast, ρυχος, a bill or beak.

[d] Platypus, from Πλατυ-πους, broad-foot.

[e] Dinotherium, from Δινος, terrible, θηριον, beast.

At the time of their visit to New Zealand, in the year 1840, the bones of the great fossil bird had not been obtained, but they had been spoken of. Other fossil bones were found in abundance; an account of which will appear in the publication of their papers.

In the rooms of the Geological Society of England, there are deposited three polished slabs, each about three feet square, of embedded geological remains obtained from Melville Island, New South Wales, and England, respectively; all of which agree so perfectly that they appear as if brought from the same locality.

The tropical fossil belt passes broadly from New Holland into Asia; it may cross the equator about the East London Longitude of 110 degrees, and very full accounts of organic remains through China and India are given in the geological notices of those countries.

According to Ure, page 171, "Coal exists in China in considerable quantities; there are no countries in the world richer in coal than the provinces of Chensi, Chansi, and Petchelli; says Mr. Panser, in his Mineralogy of the Chinese empire, the coal mines of China have been opened and worked for ages."

A want of precise geological information may be tolerated concerning an empire where research and information is forbidden, and where their views are only celestial. The descendants of the sun and moon do not elucidate the geological circuit through China.

In the kingdom of Ava, the Peninsula of Siam, and through the mountain region to Russia, the organic remains are largely distributed.

In the Himalaya[a] region,—the abode of snow,—and the Sub-Himalaya mountains, the coal region is large; and with it, the organic remains. "In the flanks of a range of hills belonging to the Sub-Himalaya mountains, and between the river Sutlj and the Ganges, are covered by beds of concretionary sandstone, conglomerate and loam, bearing a close analogy to those of Ava. These hills, called Sivalick, from Siva, an Indian deity, rise from 1000 to 3000 feet above the sea." "In these, deposits occur of immense quantities of fossil teeth and bones of the elephant, mastodon, hippopotamus, rhinoceros, and of several carnivorous animals, crocodiles, gavials and fresh-water turtles. Capt. Proby Cautley, of the Bengal Artillery, transmitted magnificent collections of them, which he sent to England, with bones and teeth of the same species of mastodon as found at Ava."

"But the labours of the naturalists have been more richly rewarded by the discovery of a skull and other parts of the skeleton of a creature hitherto unknown, forming a link between the ruminants and the large pachydermata.[b] From the skull it is ascertained that the animal had four horns, and it had also a proboscis. The discoverers have named it the *Sivatherium, the animal of Siva.*"

"The remains of the Sivatherium," (see Dr. Buckland's Bridgewater Treatise, note at page 76,) "were accompanied by those of the elephant, rhinoceros, hippopotamus, and several ruminantia." (Mantel, page 152.)

"Fossil monkeys of the quadrumana tribe, the nearest approach to the human species, have been taken at Sausan in the department of Gers in the southwest of France, and there have been dug up the same species in the Sub-Himalaya hills near the Sutlj by Capt. Cautley." Ibid. 244.

"Even in the Himalaya, the argillaceous beds are found with fossils which bear a close analogy to those of the lias of Europe." Mantel, 440.

According to Richard C. Taylor, there are bones of several genera of animals of the mastodon, elephant, &c. in the collection of the College of Physicians, in London, which have fallen with avalanches from the Himalaya mountains at the height of 16,000 feet.

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[a] Himalaya, from "Hem"—snow.

[b] Pachydermata from *παχυς*, thick—*δερμα*, skin.

The organic zone thus approaches the region from whence its circuit first began.

From the disposition to adhere closely to the evidences of the geological connexion, reference has been but casually made to the various stratifications of accompanying formations; but these will follow in their general order.

Under the scientific arrangement, the carboniferous region is considered to form part of the transition series, and to come on with the first evidences of organic life,—when " the earth was without form and void"—at the early period of the creation.

The writers on the succession of the strata of the earth, and the lower formations of organic remains; have come to the conclusion that the tropical products have grown upon the earth during the time of a warm or hot temperature, as the earth had been cooling from a state of great internal heat. Because the fossil productions of a climate of great warmth have been found extending, *in places*, to the coldest northern and southern latitudes, where they could not have been produced and could not have lived under the present temperatures.

It must therefore be observed that the theory advanced in this essay offers a substitute for that hypothesis, and represents that the clothing of the earth, and its vegetable and animal life, may have been formerly effected under the same influences we now experience, but only under a different position of the earth to receive them.

It cannot be doubted but that, by continued researches in the direction pointed out, this theory will be further supported, although the tropical remains in this organic zone may not occupy the breadth of 47 degrees, or near 3000 miles, comprised within the present tropics, and notwithstanding the oblique course it formerly made around the earth in its passage across the torrid, and nearly across the temperate zones.

Or if it should be discovered that some partial portions of fossil deposits and coal may be found without the strictly defined bounds, they may be regarded as sporadic cases, unless they may be of sufficient extent to contravene the general theory; because the variations in the earth's surface are very great. Many of the mountains rise to the height of three or four miles, and according to Charles Lyell, have been raised from the deep, and, like the Alps and Pyrenees, have marks of oceanic deposits upon them.

And Mary Somerville, (in the Connexion of the Physical Sciences at p. 63,) states that "not only the density of the ocean is inconsiderable, but its mean depth is very small. There may be profound cavities at the bottom of the sea, but its mean depth does not much exceed the mean height of the continents and islands above its level; on this account immense tracts of land may be deserted or overwhelmed by the ocean; as appears really to have been the case."

And at page 86—"the loftiest mountains on a globe of six feet in diameter, would be represented by a grain of sand, and the depth of the ocean by a scratch on its surface, consequently the gradual elevation of a continent or chain of mountains above the surface of the ocean, or their depression below it is no very great event, compared with the magnitude of the earth and the energy of its subterranean fires, if the same periods of time be admitted in the progress of geological as in astronomical phenomena, which the successive races of extinct beings show to have been immense."

Thus many great irregularities and displacements have been occasioned by elevations and depressions of the land; as where mountains, being raised from the ocean, form the polynesian districts, and sinuosities are made by the depression of the alluvial planes.

Even in England, coal is found from the surface to the depth of 1200 feet, and in strata from a mere visible line to a depth of 30 feet; while in the state of Pennsylvania, it forms the interior of mountains. To what great convulsions the earth must have been subjected!

From a consideration of such causes of irregularity in the changes of the earth, it is proper to allow for some variations of localities in an hypothesis which may account with great consistency for the general situs of the organic remains of a former world.

The facts brought together in this essay are intended to establish as a general principle:

1st. That there remains around the earth a uniform zone of former vegetable and animal life to which the fossil remains belong.

2d. That this zone has been tropical or torrid, and passed through nearly all the present climates.

3d. That a uniformity of production has been found upon it in many places, but it has not been previously noticed that this has pertained to a general connexion or has referred to any particular condition of the earth.

If from the novelty of the proposition, the theory should elicit examination, it is hoped that it will be exercised without prejudice. There are several theories afloat which have the authority of science, but do not account satisfactorily for the phenomena presented to them.

Many of the elucidations of Mary Somerville, in her treatise on "The Connexions of the Physical Sciences," have been adverted to, in the course of this essay. But it is not intended to adopt the geological views in regard to the organic remains which she seems to accredit; they are stated by her to be in accordance with the suggestions of Charles Lyell, who assigns the cause of the immense animals of a warm atmosphere being found as they are, preserved in northern ices, to the mild effect of marine influences upon insular situations, and assumes the former existence of a state of things at the north, calculated to produce this mildness.

On this head she writes in The Physical Sciences, at p. 86—"Now it appears that most of the European, North Asiatic, and North American Continents, were raised from the deep after the coal measures were formed, in which the tropical plants were found, and a variety of geological facts indicate the existence of an ancient and extensive archipelago throughout the greater part of the northern hemisphere."

And then she states Charles Lyell's ideas respecting the productions of the region to be as follows, p. 87:

" Mr. Lyell is therefore of opinion, that the climate of these islands, must have been sufficiently mild in consequence of the surrounding ocean to clothe them with tropical plants, and render them a fit abode for the huge animals, whose fossil remains are so often found."

But neither of these authors have referred to a satisfactory cause. For these organic relics at the north, are part of the relics of a former tropical zone, and could not have been produced there by any *mildness of surrounding ocean,* nor under a high temperature of the earth while *cooling from a state of internal heat:* both of which views are too conjectural, and insufficient to account for the phenomena. The former would have still subjected the plants and animals of the north, to the alternate and severe changes of the arctic circle, and the latter would have spread the tropical remains indiscriminately over all the regions of the earth.

Under nothing less than an indigenous tropical atmosphere could immense growths of tropical plants have been produced, to be consolidated into masses of coal, and to support superincumbent mountains.

It is well known, that of all the products of the earth, the tropical plants are the most sensitive; incapable of change of place, killed by any reduction of the atmosphere, and perennial only under seasons of uniform warmth in the tropical zones, where it is necessary that for many of them, the air should be moderated by marine influence.

But Mary Somerville, in a previous part of her work, appears to rely fully upon the *state of climate* previously existing at the north, to have given existence to the tropical products; and thus far to sustain the principle of this theory, she remarks:

" Previously to the formation of ice at the poles, the ancient lands of northern latitudes might, no doubt, have been capable of producing those tropical plants preserved in the coal measures, if indeed such plants could flourish without the intense heat of a tropical sun."—Somerville, p. 83.

And even Charles Lyell, in his Geology, Am. edit. vol. i. p. 110, refers to better evidence than he had before stated, for the production of tropical plants so far at the north.

"Is not the bright light of the equatorial regions as indispensable a condition of their well being, as the sultry heat of the same countries? And how could they annually endure a night prolonged for three months?"

An extract from Mary Somerville's work, tends to give her ideas upon the changes consequent to a different position of the earth. See page 87.

"It is evident from the marine shells found on the tops of the highest mountains, and in almost every part of the globe, that immense continents must have been elevated above the ocean, which must have engulfed others. Such a catastrophe would be occasioned by a variation in the position of the axis of rotation on the surface of the earth; for the seas tending to a new equator, would leave some portions of the globe, and overwhelm others."

"A displacement of the position of the poles of only two hundred miles, would be sufficient to produce those effects; but the earth and planets differ so little from elipsoids, that any vibration from one axis to another, produced by the primitive impulse which put them in motion, must have ceased soon after their creation from the friction of fluids at the surface. Yet the change of the ocean waters must have been great, for the mean depth of the Pacific Ocean is supposed to be not more than four miles, whereas the equatorial diameter of the earth is 26½ miles greater than the diameter through the poles."

The changes of the surface of the earth to produce the successive stratifications upon the land as far as these are regular, may be attributable to the progress of the perihelion point around the ecliptic. It is now in 9° of Capricorn, and near to the winter solstice; the declination of the orbit is 23° 27′ 38″·81 and the maximum of the sun's action on the earth at the different extremes of the orbit, is as 61 to 57, hence the greater proportion of water drawn into the southern hemisphere.

The perihelion period is 20,984 years, and in half that time when the attraction is removed to the north, the waters will be drawn again into the northern hemisphere, and the continents of Europe, Asia, and North America, will be covered again, as they probably have been repeatedly heretofore, by water. A slow, but certain progressive change in the relative geology of the earth. (Calculations from M. Somerville, page 85, and Phillips' Geology, page 296.)

It ought not to be represented that these ideas interfere with the present system of geology, because the internal stratifications are now so satisfactorily explained to be in consecutive order, and include the vegetable and animal remains in their specific formations according to their several ages. That system is not contravened, but confirmed by them.

By internal agitations, mountains have been elevated over nearly all the world, and the strata of the several formations brought up, consisting of the inorganic and organic elements, as seen in the dismemberment of the larger fishes and shells, in the chalk, flint, limestone, marl, &c., and the detritus along the ocean shores: but tropical remains do not appear to have been disinterred unless it is where the mountains have been within the region of this organic zone; although there are many situations where the organic formations have to be sought for at great depths, where the strata have only approximated to the surface, and where—overrun by diluvium—they have the character of a newer geological era.

But the theory will be confirmed by a general view of the present physical appearance of the earth. No testimony has reached us of there being to the northward or southward of this zone any extensive formations of vegetable or animal fossil remains.

In *North America*, no body of coal has been found north or south of the great mass running centrally through the United States, unless it is the small isolated deposit of bituminous coal in Eastern Virginia, which is said to repose on the granite.

In *Europe*, the account of the organic region is described heretofore in this essay.

In *Asia*, as far as accounts have been obtained, the organic range passes through China, Ava, Himalaya, and to the southward of Russia.

In *Africa*, if there be any substrata of fossil deposits in its general low soils, they have not been written of.

Within the present tropical lines of the revolution of the earth, there is no evidence of a uniformity of tropical organic relics; and they are scarcely found within the torrid zone, unless where the organic zone is crossed by it, as at present in New Holland and China, yet they appear on each side of it to the north and south, in both hemispheres.

To a great extent, therefore, this organic zone has been marked out specifically, though unconsciously, at various localities, by various observers.

The marine deposits and tropical remains, traced, as described through the basin of Europe, between the south of Sweden and the Alps, exist in one connexion through Germany, Holland, England, and France.

By the researches of Sir H. Bonnycastle, they were traced through Newfoundland, and by Charles Lyell through Canada and the United States, and found to pass through North America, in the same course, to Mississippi and Texas: and *thus one-third of the circuit of the earth gives specific testimony in favour of the problem.*

It is true that the further parts become isolated; but this arises from the intervention of the ocean. For the zone appears in all its analogues where it crosses the landed parts of the globe, unless where the granite region comes up from beneath, and takes the superior place in lieu of subsequent formations.

Whether the fossil salt has any general relation to the coal or to the organic range, it is not intended to be assumed, but it has very much accompanied it, and the discovery of both have gone on together. For, this country had to depend upon commerce for its supply, from the ocean or from foreign mines, until it was procured from the fossil salt deposit of the great organic range, and until it was found that in this range there was an inexhaustible supply of coal, it was only to be obtained from the eastern end of our own coal ranges, in England.

Although the present movements of the earth are so ordered as to give assurance, not only of long previous, but of future regularity and precision, yet there are on its surface various effects which must be attributable to special causes, some of which do not continue to act upon it.

The great elevation of the mountains, particularly those of the north of Europe, and those of the south of Europe, being urged into large masses, leaving the eastern part of the country at a low level—that of the mountains of North America, passing southwardly into high diagonal ranges, leaving the country at scarcely an average height of surface—and many other similar geological inequalities, lead to the conclusion that they have been produced very suddenly, and by some internal energy. In addition to this, the singular predicament of the large southern animals which have been overtaken and preserved for ages in the ices of a northern ocean, in which they never could have been sustained, is unaccounted for in any estimate which can be made of the regular course of physical causes.

But, at any rate, by the precession of the equinoxes, by the progress of the perihelion relation of the earth's orbit, and other astronomical influences, very important alterations are continually going on; though these, being gradual, will subject the earth to no convulsions; from these there can be no sudden change of zones, or of vegetable or animal life; their progress, according to the will of the Creator, has become more and more developed, as the talent and industry of the intellectual part of the creation has been applied to understand them.

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It was intended that this essay should have been accompanied by a diagram to exhibit the Organic Zone in its passage on a right line around the earth, and it is omitted with regret on account of the difficulty of the figure; for it is only by an orthographic or stereographic projection that the globular figure of the earth can be mathematically represented on a plane surface; and in these, the line of the zone would have to be drawn like the ecliptic, which though a straight line on the globe is represented on the map by a double curve through the hemispheres; most of the parallels of latitude and the meridians having also to be curved in both projections.

The Mercator's projection, from its extended proportions, is less suitable than either of the others.

As the zone, therefore, cannot be represented in a straight line unless it is upon the globe; when there is not one at hand, an appeal must be made to the best geographical recollections of the student.